Office Equipment

There are a lot of mysterious things about computers, but energy use isn't one of them. The computer that sits on your desk may look innocent enough, but it silently consumes $40 per year in electricity. Although $40 isn't enough money for you to justify throwing out your old computer and buying a new efficient one, it is enough money that you should consider energy use when you shop for a new computer.

Office equipment is the fastest growing electrical load in the business world. Unfortunately, computers, faxes, printers, and copiers waste energy when they remain on and idle. To reduce this waste of energy and the pollution associated with it, manufacturers of just about every major brand of office equipment have partnered with EPA to introduce ENERGY STAR-labeled machines that will automatically power down when not in use. The chart on this page shows the typical savings you may achieve if you buy ENERGY STAR-labeled office equipment instead of its inefficient equivalents.

It does add up. What would happen to your profits if you could cut all of your costs by 50 percent?

In addition to its direct energy consumption, office equipment gives off heat. Your air-conditioning unit must work harder to remove this unwanted heat. Introducing energy-efficient office equipment provides the added benefit of lowering utility bills due to reduced air-conditioning loads. This is Stage Three of the ENERGY STAR program. Some of the savings will be given back in the winter.

Here's the kicker: You don't have to spend anything extra to get this savings. You also don't have to sacrifice any performance, and payback time is 0.0 years. Your choices remain virtually the same as before because so many major manufacturers have chosen to join ENERGY STAR. Just specify ENERGY STAR products or look for the logo on display models. ENERGY STAR offers a number of informational fact sheets and brochures on ENERGY STAR office equipment and maintains a detailed list of qualified products that is updated monthly. For information on ENERGY STAR-labeled office equipment, visit www.energystar.gov/products.

I Don't Want To Wait To Save

Modify user behavior so that it includes turning off computers, printers, and copiers at night, over the weekend, and even when the equipment is not being used for a considerable amount of time.

Energy-efficient office equipment can lower utility bills due to reduced air-conditioning loads, as well as the lower energy cost of the equipment itself.

Typical Savings If You Buy ENERGY STAR-Labeled Office Equipment

Office Equipment	Annual ENERGY STAR-Labeled Office Equipment Cost Savings	Percentage of Total Operating Cost
Computer	$19	49%
Fax Machine	$13	52%
Printer	$39	65%
Copier (Medium)	$57	57%
Copier (Large)	$130	58%

Consider networking your computers to share printers so that fewer printers remain idle during the day.

Your computer may already have energy saver software installed; if so, make sure that it is enabled.

What You Will Save

	Energy Savings (kWh/yr)	Cost Savings per Year at Different Electric Rates ($/kWh)			Percent Savings
		$0.06	$0.08	$0.10	
Save Now					
Turn 24-hour equipment off at night so it runs only 9 hours per day.					
Savings per Computer	675	$41	$54	$68	61%
Savings per Large Copier	6,600	$396	$528	$660	56%
Save Later					
Replace older 24-hour equipment with new ENERGY STAR equipment that is used 9 hours per day.					
Savings per Computer	795	$48	$64	$80	72%
Savings per Large Copier	8,910	$535	$713	$891	75%

How Does It Work?

The following facts on ENERGY STAR office equipment will help you to be a better shopper and decisionmaker when buying and operating new equipment.

Computers. ENERGY STAR-labeled computers automatically power down to 30 watts or less when not in use and are available from almost every manufacturer. To optimize your ENERGY STAR-labeled computer, make sure that the power management feature is enabled and that you have set it to the shortest acceptable time for your operation. Laptops use less energy than desktops.

Monitors. These are among the biggest savers. When not in use, ENERGY STAR-labeled monitors automatically power down to 30 watts or less. If you are going to implement a screen saver, make sure you select one that is compatible with the monitor's power management feature. Most screen savers available in the market actually prevent the monitor from going into sleep mode. Furthermore, turning monitors off at night and during the

Make the Right Call. A typical 20-computer telemarketing center uses a lot of energy for computers and cooling. ENERGY STAR-labeled computers would cut the annual electric bills by about $500.

weekend is a practice that will provide you dual benefits. It not only reduces energy costs but in fact extends the life of the units by preserving the phosphorus substance that screen savers were designed to save. Finally, when buying a new monitor, consider the size of the unit as part of your purchasing criteria. Large monitors use more energy, so buy the smallest monitor that suits your operation.

Copiers. Approximately 7 million copiers are in use in homes and businesses across the United States. Copiers are the most energy-intensive type of office equipment, because they sit idle for long periods of time. ENERGY STAR-labeled copiers are equipped with a feature that allows them to automatically turn off after a period of inactivity, which reduces their annual electricity costs by more than 60 percent. There are also several strategies that you can implement regardless of the type of copier you operate. You can purchase a correctly sized copier, use the 1- to 2-sided copy option to ensure that the duplexing feature is being used, and run copies in batches to decrease the time your copier spends in the high-powered mode.

Printers. ENERGY STAR-labeled printers can cut your electricity use by over 65 percent. ENERGY STAR-labeled printers that have double-sided printing capabilities will reduce your paper costs by $30 a month and paper use, which also helps to save trees. Networking one printer for several users is one of the best strategies you can implement to reduce energy consumption and save your business money. Not only will you benefit from reducing your energy costs, but you will also lower your capital expenditures by purchasing fewer printers. ENERGY STAR printers also automatically power down to less than 10 to 100 watts, depending on the number of pages per minute produced and printer type (i.e., standard-sized, color, large/wide-format, and impact). This automatic "power-down" feature cuts the printer's electricity use. Using the power-management feature means your printer will produce less heat. This contributes to a cooler and more comfortable work space, and reduces air-conditioning costs. By generating less heat, your printer may last longer and be more reliable.

Facsimile Machines. Because fax machines remain on 24 hours a day, they hold huge energy savings potential—up to 50 percent. ENERGY STAR-labeled fax machines save energy in two ways. They go into sleep mode after being idle for a set period of time, and they scan double-sided pages. You will not miss any faxes if the fax machine goes into sleep mode. For example, a medium-speed ENERGY STAR-labeled fax machine uses 25 percent less energy in sleep mode than in standby mode when it is immediately ready to send/receive faxes.

Scanners. Scanners are one of the fastest growing segments of the office equipment market. ENERGY STAR-labeled scanners enter "sleep" mode after 15 minutes of idle time, which saves energy and money on utility bills.

Multifunctional Devices. The ENERGY STAR program also qualifies multifunctional devices. A multifunction device's primary function is copying, but it is also able to print, fax, or both. ENERGY STAR-labeled multifunction devices power down to a low-power mode then a sleep mode when not in use. Many small businesses are taking advantage of this type of equipment, so you should make sure you always look for the ENERGY STAR label when purchasing this type of office equipment.

Networking several computers to one printer can reduce energy consumption and save your business money.

If everyone used the double-sided feature of ENERGY STAR labeled copiers, we could save one million tons of paper – enough to go around the world 1,400 times.

Paper

You may not think of your paper use as an area to save energy, but it is. Paper producers in this country buy more than $3.5 billion of energy each year. In fact, every $5 ream of paper you avoid using eliminates about $0.34 worth of energy production and related emissions by a paper mill, not to mention the energy spent to harvest and ship the trees and to ship the paper to your desk. In this section, we review simple steps to optimize your use of this valuable resource. You will save money, reduce waste, and protect our nation's forests so they can be enjoyed by generations to come.

Double-Sided Copying

Copy machines often have the capability to automatically copy on both sides of a piece of paper. Selecting 2-sided copying for long documents, articles, or drafts can instantly reduce your paper use without adding any associated inconvenience. For more information, see the chart on this page.

Recycled Paper

Many paper products currently contain some recycled content. Recycling allows fibers to be reused in the production cycle so that fewer trees are required to provide the same amount of paper. Cardboard and newsprint may contain as much as 75 percent recycled content, while standard copy paper often has less than 5 percent recycled content. Selecting papers with high recycled content can be the simplest way you can help preserve our forests.

Recycled papers and other products are rated by their "post-consumer content" and "total recycled content." These percentages are usually in very small print on the paper packages. "Post-consumer content" is the more important factor and refers to fibers that have been used and are then collected through recycling programs. "Total recycled content" refers to the total nonvirgin content of the paper, including production scraps and post-consumer fibers. Paper does not have to be conspicuously labeled "environmentally friendly" to have a high recycled content, so a little research can identify some real bargains.

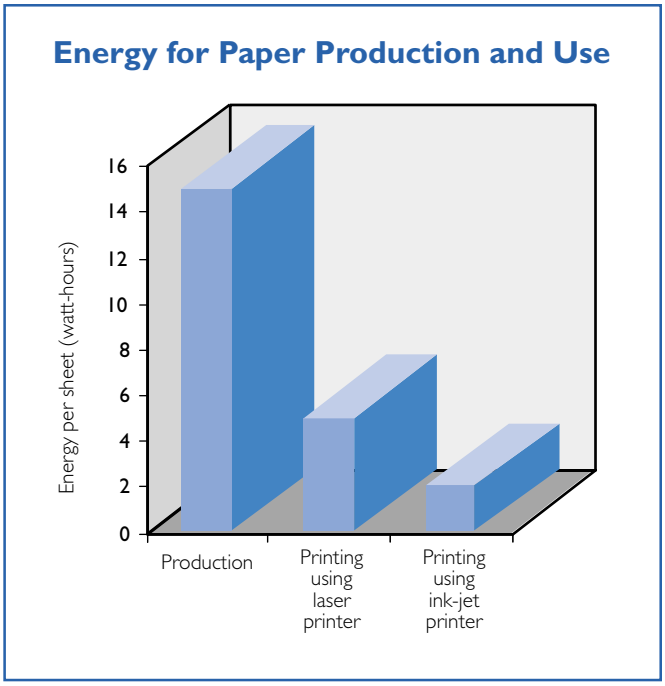
Paper can have a high recycled content even if it is not conspicuously labeled "environmentally friendly."

Double-Sided Copying Makes Great Business Sense Because It:

- Reduces the amount and cost of paper used.
- Lowers mailing costs because the paper amount and weight are reduced.
- Produces less paper output, which takes up less storage space in offices.
- Often has a more professional appearance.
- Reduces the environmental impacts of paper throughout the paper production process; therefore, fewer trees are harvested, there are lower chemical and energy inputs during pulping, and transportation and storage costs are reduced.
- Shows a business' commitment to environmental protection.

Andrew Duncan, *Greening of the Campus Conference Proceedings*. Ball State University, Indiana. 1996. Page 162.

Conserving paper is an important step in saving energy, lowering pollution, and ensuring the long-term health of our forests.



Recycling

Many municipalities sponsor programs to collect paper and fiber products such as corrugated cardboard, paperboard (cereal boxes), white, colored, or glossy paper, newsprint, and books bound with glue. Collecting and returning your used paper to a recycling center will return that fiber for reuse and may reduce your waste disposal costs. If you are a large user of one or more of these products, you can set up your own collection program with a local salvage company. You will be paid by the ton for the materials that you collect, and you will save from reduced disposal costs.

Be sure to include a statement such as "Printed on 50 percent recycled paper containing 20 percent post-consumer waste" on printed materials to highlight your company's commitment to the environment.

There are also creative ways that companies are reducing their paper use and streamlining their operations. Some items that are routinely issued as memos to all employees can simply be posted on area bulletin boards. And instead of making a copy for each person, you can circulate many documents using a routing tag containing the names of relevant personnel. An employee checks off his or her name and passes the material to the next person on the list.

Many businesses have revolutionized their operations through corporate e-mail and local area networks (LANs). In addition to greatly improving internal communication and facilitating team projects, these tools can significantly reduce paper use by replacing memos, time sheets, forms, and draft documents.

Water Heaters and Water Use

Most small businesses use hot water even if only for employee hand washing. Restaurants, hotels, and other businesses that use hot water for business purposes such as dishwashing and doing laundry can spend 25 percent or more of their total energy bill on hot water. Fortunately there are many low-cost, easy-to-apply methods for reducing your hot water costs.

Water Heaters

Turn off your water heater. Although this may seem obvious, it really is a great idea. Buy a 7-day thermostat (you can get one for about $30) to turn off your electric water heater at night and on weekends and to turn it back on one hour before your business starts up in the morning. If you have a big water heater, you can get even more aggressive and turn it off an hour or two before quitting time. The already-heated water will be sufficient for late-day needs. You'll save anywhere from $10 to $50 per year with a water heater timer.

Along the same lines, consider shutting off a dedicated water heater that is rarely used and turning it on only when it is needed.

If you use a circulating pump, be sure that it is shut off when the facility is unoccupied. Again, a timer will help you remember. Circulating pumps increase heat loss through pipes that circulate hot water. A 1/8 horsepower pump that is turned off for 2,000 hours per year will save you $25 in pump energy alone.

Lower the thermostat setting. The hotter the water temperature, the faster you lose energy through the pipes and water heater tank walls. Therefore, lower the thermostat to provide hot water at the lowest acceptable temperature. Some tasks, such as doing laundry or washing dishes, and some businesses, such as health care facilities, require higher water temperatures than others. These temperatures may be set by state and local codes. A small office with an electric water heater that is used only for hand-washing purposes would save about $10 per year if the setting is changed from 130 degrees to 120 degrees at no cost. See the chart on page 58 for some recommended hot water temperatures.

If one task, such as laundry, requires significantly higher temperatures than other tasks, it may be more efficient to reconfigure your piping to include a blending valve. (The hottest water should be piped directly from the heater to the high-temperature task; the water for the remaining tasks should branch off and pass through a blending valve, which mixes in cold

The hotter the water temperature, the quicker you can lose energy through the pipes and water heater tank walls.

Summary

To optimize energy use of your water heater:

- Minimize hot water use.
- Provide hot water at the lowest temperature that is acceptable for the task.
- Insulate the tank and pipes.
- Obtain hot water from the most efficient sources.
- Perform periodic maintenance procedures.

Typical Recommended Hot Water Temperatures

Process	Temperature (degrees Fahrenheit)
Hand Washing	105
Showers	110
Laundry *	160
Dishwasher Rinse **	180–195

* Check code requirements.
** Many dishwashers have booster heaters. Check with the manufacturer to determine minimum temperature requirements.
Source: American Society of Heating, Refrigeration, and Air-Conditioning Engineers

Before you buy a new water heater, consult the EnergyGuide label so that you select an efficient model.

water to reduce the water temperature for the other tasks.) Alternatively, you may wish to install separate heaters for high-temperature and low-temperature tasks or to provide booster heaters for high-temperature tasks. Some machines provide their own booster-heating mechanisms.

Insulate your tank. To reduce heat losses in your hot water system, make sure that your hot water storage tank and the hot water pipes connected to it are insulated. Few hot water tanks are totally uninsulated nowadays.

Move your water heater. If you are remodeling, take the opportunity to relocate your water heater as close as possible to the main point of water consumption. This will reduce heat loss from the pipes.

Buy a new water heater. If you buy a new water heater, be sure to consult the EnergyGuide label on the appliance so that you select an efficient model. Consider using a heat pump water heater, particularly in situations where the simultaneous cooling it would provide would be useful. A relatively new and more efficient technology, heat pump water heaters remove heat from the surrounding air and transfer it to the water. Because these water heaters also cool and dehumidify the surrounding air, they are particularly beneficial in warm, humid areas such as kitchens and laundry rooms. Another excellent alternative is tankless, instantaneous, on-demand water heaters, which are quite popular in Europe. They are growing in popularity here, too, especially in areas where relatively small amounts of hot water are used on occasion. Tankless water heaters eliminate tank losses and are great for office buildings that only have sinks. Tankless water heaters typically supply up to two gallons per minute of hot water, about the same as required for a shower and more than enough for most office sinks. One catch is that they may require heavier wiring, so check with your contractor before making a decision.

Or, don't buy a new water heater. Consider turning your standard water off except for emergencies and using "free" waste heat recovery to meet some of your water heating needs. Waste heat sources include laundry or dishwashing rinse water, steam condensate lines, and refrigeration equipment.

Maintenance

To maximize savings and keep your hot water system operating efficiently, you should perform periodic maintenance procedures. Storage-type water heater tanks should be flushed out about annually to remove sediments that reduce system efficiency. (Flushing involves opening the drain valve at the bottom of the tank and drawing off water until the water runs clear. Follow your manufacturer's instructions. In areas with high mineral content in the water, you may need to do this more often.) The burners of gas- or oil-fired water heaters should be tested and adjusted annually to make sure that the fuel is being burned as efficiently as possible. In addition, it is good practice to periodically flush your fixtures with very hot water to control bacteria growth.

Solar Water Heating

You really can't do any better than solar energy for energy savings and for the environment. Solar water heaters are simple devices that capture the sun's energy to heat water for ordinary use. They are often piped directly into systems with conventional water heaters, lowering your energy costs while still providing hot water on overcast days. Solar water heaters are extremely cost effective for heating swimming pools, where other types of heating can be very expensive.

Solar water heating is an established technology used throughout the world. In California, solar systems are the only type of pool water heating allowed by many local codes. Even the pool built for the Atlanta Olympics is heated with a solar system, though this was a unique, showcase system. While you may think of the large number of units in sunny areas like Florida or California, you may be surprised that even in the rainy areas of the Pacific Northwest, solar water heaters can pay for themselves in less than 10 years. Check with your local utility, your state energy office, and your tax preparer to find out about incentives or tax benefits that apply to solar energy systems. You can get more information, locate a solar installer, or find a supplier for a do-it-yourself system by contacting the American Solar Energy Society at (303) 443-3130 (www.ases.org) or the Solar Energy Industries Association at (202) 628-7745 (www.seia.org).

Water Use

You may wonder why an energy manual is discussing water use. Certainly within your own facility it costs money to heat the water. But the water company also spends a lot of money on energy to pump and purify the water it delivers to you. So a portion of your water bill is actually an energy bill. The same logic holds true for sewage treatment. If you have a business such as a restaurant, bakery, food-processing plant, hotel, nursing home, or laundry and your business uses large amounts of water, you will benefit even more from water use optimization.

Like everything else, savings from water measures can vary. You can save on the cost of the water, you can save on sewage, and you also can save on energy costs for pumping or heating processes. Because savings come from so many sources, water reduction upgrades are frequently profitable.

Efficient showerheads and faucet aerators are inexpensive devices (they generally cost between $2 and $20) that screw into existing pipe fittings to help reduce water consumption. These devices reduce the amount of water used in common daily tasks. If your business is a hotel, motel, or restaurant, you can use these devices to significantly reduce your water-heating bills as well as your water bills.

By repairing a seal that leaks a drop of electrically heated hot water every five seconds, you can save about 400 gallons of water, 85 kilowatt-hours

Solar water heaters use the sun's energy to heat water and can help you lower your energy costs.

Solar water heaters are simple devices that capture the sun's energy to heat water for ordinary use. They are often piped directly into systems with conventional water heaters, lowering your energy costs while still providing hot water on overcast days

Success Stories

Water Heater Tune-Up

Consider the case of an office manager of a 2,000-sq.ft. office building who discovered a leak in the pipes from a 40-gallon electric water heater. While repairing the leak, she decided to install an insulated blanket wrap around the water heater to prevent additional heat loss. The cost of the installation, the insulation, and the repair was approximately $40. By setting the water heater thermostat to a setpoint of 120 degrees Fahrenheit, the office manager saved $35 per year and had a 1-year payback. That extra $35 goes to business profit year after year.

Repairing a seal that leaks a drop of electrically heated hot water every five seconds can save you about 400 gallons of water, 85 kilowatt-hours of electricity, 125 pounds of carbon dioxide, and $10 per year.

(kWhs) of electricity, 125 pounds of carbon dioxide, and $10 per year.

Automatic controls such as valves or springs with sensors that turn faucets off can also help save water. The spring-loaded valves will automatically turn the water off when the user releases the handle. Photocell-equipped sensors are gaining popularity in controlling water use in restrooms. Almost all major airports have installed them due to their high intensity of use and because luggage and other articles tend to tie up travelers' hands. These sensors detect motion and shut the water off after the user leaves.

The amount of water used when flushing toilets can be drastically reduced without compromising efficacy by using new-design, low-volume toilet fittings. These fittings can reduce the amount of water used per flush by about 66 percent by using improved water flow characteristics. High-quality, pressurized, low-volume toilets tend to cost about $200 more than gravity toilets, but they are worth the premium if the toilets will be flushed more than 20 times per day.

New washing machines with a horizontal axis design use much less water than the older types of washing machines. The new machines can help save water as well as reduce water heating costs for laundries, hotels, and nursing homes. They also can reduce the amount of detergent that is used for washing the same amount of clothes. The newer design machines occupy less space and do not produce as much heat as the older design washing machines, which use much more hot water; thus, your rent and air-conditioning requirements can also be reduced. New machines also remove more water from the laundry during the spin cycle, thereby greatly reducing drying time and energy use.

Xeriscaping and Gray Water

Wouldn't you rather be having fun in the summer instead of taking care of the landscaping around your facility? Xeriscaping (*xer* means "dry," from Greek) is the technique of utilizing native, hardy, low-maintenance plants for landscaping. Xeriscaping can save you money on your water and maintenance costs. And because native plants cope better with your particular soil, climate, and insects, they require fewer pesticides and less fertilizer (something your 4-legged neighbors and feathered friends will appreciate). A general Internet search for "Xeriscape" will provide many resources, including several state programs. Also visit www.greenbuilder.com/sourcebook/xeriscape.html and www.xeriscape.org.

We also recommend:

- Colorado Spring Utilities (Xeriscape Demonstration Garden): www.csu.org/xeri.
- South West Florida Water Management District (Xeriscape): www.swfwmd.state.fl.us/conservation/xeris/swfxeris.html.
- Green Building Program (Sustainable Building Sourcebook): www.greenbuilder.com/sourcebook/xeriscape.html.

Water from sinks or washing machines that may contain soap but is otherwise still clean is called "gray water." Many drought-prone areas of the country have encouraged use of this gray water for landscaping purposes. St. Petersburg, FL, has even installed a city-wide system that provides reclaimed water for 7,000 homes and businesses. Other cities do not permit reuse of gray water at all because of water quality concerns. For more information on promotional programs or restrictions on gray water use, call your local building permits office or check out the EPA Web site at www.epa.gov.

If your business is involved in any type of manufacturing or processing that uses water, you should consider reusing the waste water in some other process where your water quality requirements are not as stringent. For example, a growing microbrewery in Portland, OR, implemented an upgrade in 1992 that allows it to use its extra processing water for washdown. The plumbing was tricky, but the upgrade was ultimately very low in cost and saved a lot of natural gas.

Where Can I Learn More?

If you want more information on smart water heating, the Gas Manufacturers Association publishes a *Consumers' Directory of Certified Efficiency Ratings* for electric, gas, and propane water heaters.

We also recommend:

- Department of Energy: www.eren.doe.gov/erec/factsheets/watheath.html.
- Indoor Water Efficiency Spreadsheet (contains information on calculating energy savings): (413) 253-1520; http://solstice.crest.org/environment/gotwh/general/indoor-water/index.html.
- Iowa Energy Center (for information about buying, installing, and upgrading hot water systems): www.energy.iastate.edu/.
- Water Wiser, The Water Efficiency Clearinghouse (for information on water efficiency and conservation): 1-800-559-9855; ww.waterwiser.org.
- Wisconsin Energy Bureau (for general information on water heaters plus a compilation of the GMA ratings): www.doa.state.wi.us/depb/boe/index.asp.

Success Stories

Community Mercantile, an 18,000 sq.ft. grocery in Lawrence, KS, is saving about $55,000 yearly, and the 714,286 kWh saved will prevent about 1,002,857 pounds of carbon dioxide emissions. Andy Lewis, owner, says, "I was frankly amazed at the quality of savings, and how that translated into coal not being burned and carbon dioxide and sulfur not being released into the atmosphere." The upgrade included high efficiency HVAC units, programmable thermostats, a new white, reflective roof, more insulation, T-8 fluorescent lamps with solid-state ballasts, low-E insulated windows, refrigerated case covers, "tankless" water heaters, compact fluorescent lamps (CFLs), and LED exit signs.

Businesses involved in any type of manufacturing or processing that uses water should consider reusing the waste water in some other processes where water quality requirements are not as stringent.

Refrigeration

Refrigeration equipment is one of the highest energy users in the competitive, low-margin supermarket, convenience store, deli, and restaurant businesses. Upgrades that reduce your refrigeration costs can make your small business more competitive.

There have been many great developments over the past 25 years to make refrigeration systems more efficient. The down side of all these innovations is keeping up with them. Big chains have experts with full-time responsibility for such matters. You don't. So look for help. If your equipment is more than 10 years old, call a local refrigeration case supplier and request a checkup. You'll be surprised at all the possibilities. A typical new residential refrigerator uses about 800 kilowatt-hours per year and costs about $64 per year to run. This is *less than half* what you'd pay for the same size unit that is 20 years old.

No-Cost Action Items for the Refrigeration Amateur

Keep the doors shut. Repeated fluctuations in temperature will damage your food quality and will cost you money.

Check the temperature settings. If your settings are lower than necessary, chances are you are wasting energy. The most common recommended settings are between -14 degrees and -8 degrees Fahrenheit for freezers and between 35 degrees and 38 degrees Fahrenheit for refrigerators.

Properly load your refrigerator. Overloaded units disrupt air flow necessary to cool the products efficiently, and allows deterioration to occur. On the other hand, underloaded units waste energy. If you have partially filled units, consolidate them.

Properly position refrigeration units. Don't put your soda display case right next to your deli bun warmer or in direct sunlight. Extra heat makes your refrigerator work harder to maintain the desired cool temperature. Make sure that there is enough ventilation for your refrigerator's mechanical equipment. A 1-inch gap on the sides and a 4-inch gap at the back are recommended for refrigeration units to allow the condenser and fan to have access to a steady flow of air.

Clean the cooling coils. Dirt accumulation impairs heat transfer and lowers refrigeration efficiency and capacity.

Check the door seals. Tight seals and properly closing doors prevent warm air from entering the unit, which reduces cooling energy and prevents frost buildup. Use this rule of thumb: If you can easily slide a dollar bill into the seal, have the seal adjusted.

The above actions can save you between $5 and $25 per year. These actions can also improve your product quality and extend the unit life. At no cost except a few minutes of

Energy Star Commercial Refrigerator

A new Energy Star Commercial Refrigerator (50 cubic feet) uses about 2,500 kilowatt-hours per year and costs about $205 dollars a year (@$.08/kWh) to run. Compared to standard commercial refrigerators, that is about 30 percent in savings!

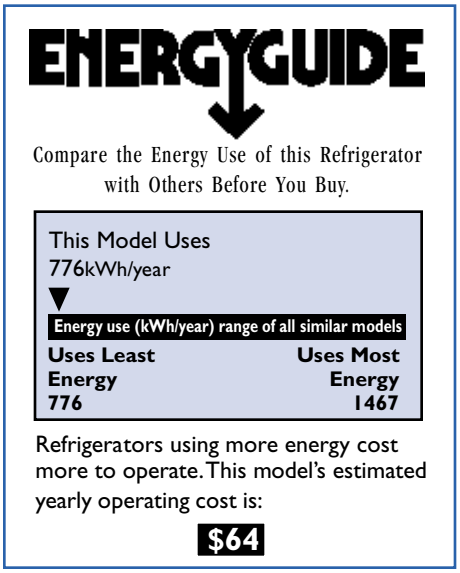
Success Stories

Inn at Wiccoppee

Rick Stein owns and operates the Inn at Wiccoppee, a well-known restaurant in the quaint Hudson River area of Hopewell Junction, NY. With a free energy audit and advice from his local utility, Central Hudson Gas and Electric, Stein is saving $1,869 annually and preventing about 25,000 pounds of pollution. His payback on upgrade costs was about seven months.

Stein's biggest single savings opportunity cost him nothing to implement. He reduced his frozen food inventory and combined it into two freezers, allowing him to unplug three other freezers. And while this simple move didn't affect the restaurant at all, Stein is saving almost $800 a year, money that goes straight to his bottom line.

Other savings required small investments but delivered good savings. These included a lighting upgrade, and replacing an electric deep fryer with a similar natural gas (or propane) fired unit, because these fuels are cheaper than electricity.



Use the EnergyGuide label to select efficient residential-size refrigerators. (Also available for other appliances.)

your time, these actions are a bargain.

Shorten defrost cycles. This is starting to get a bit technical. Fifteen minutes an hour isn't perfect for everyone or for every season. If you're in a dry climate or season, gradually decrease your defrost cycle time until you see hints of frost buildup on the coils. Back the setting up a bit, and you are optimized. This procedure, like others, can help extend the unit life.

Refrigeration Capital Investments

Specify glass doors when you buy new display cases. They bring a modern look to your store and keep cold air where you want it (with the food) and warm air on your customers. If you can find a low-cost contractor, upgrading your open display cases by adding glass doors to them will reduce your energy costs by as much as 40 to 50 percent.

Refrigeration heat recovery to water heaters or spaces is almost standard now in grocery stores with substantial hot water needs.

Request a humidistat instead of a timer to control the anti-sweat heaters in large display cases. This is similar to the defrost cycle idea mentioned earlier, but it involves automation.

Upgrade your "rack" system with a floating head pressure system. These pressure systems allow the compressor to work less when it is cool outside, and they consistently demonstrate savings of 20 to 30 percent.

Heat recovery to water heaters or spaces is almost standard now in grocery stores that have large systems with substantial hot water needs, such as delicatessens. In most cases, you can disconnect your old water heater.

Order new units with efficient lighting for new display cases. The lower wattage lights will reduce cooling costs by reducing the work done by the compressor to cool the heat generated by the lamp and may even improve the product appearance.

If you are in the market for a new refrigerator, look for the ENERGY STAR® logo—your guarantee of savings. And use the EnergyGuide label to help you identify how a particular model compares with others in the market and what its annual operating costs are. You can then base your purchasing decisions on the price you can afford to pay and the highest efficiency available in that range. Calculate the simple payback for the cost premium to see how much increased efficiency you should buy.

Specify high-efficiency evaporator fans when buying new display cases. At less than 1/10 horsepower, you wouldn't think that these little fans are a very big deal, but when considering that a grocer may use a hundred of them, it adds up. It is normally worth paying the incremental price premium when buying a new unit.

Purchase freezers and refrigerators with an Energy Efficiency Ratio between seven to nine for medium-temperature systems and from five to six for low-temperature systems.

A Note About CFCs

The major challenge that the refrigeration industry has faced is the mandated phaseout of chlorofluorocarbons (CFCs). Until recently, many refrigerators used CFC-based refrigerants. The foam insulation built into older refrigerators also contains CFCs. Because CFCs deplete the ozone layer and contribute to global warming, new refrigerants have been developed to replace CFCs and are currently available in new units or as replacements for CFCs in old units. Call the EPA Stratospheric Ozone Hotline at 1-800-296-1996 for information on converting your existing refrigerators or disposal methods.

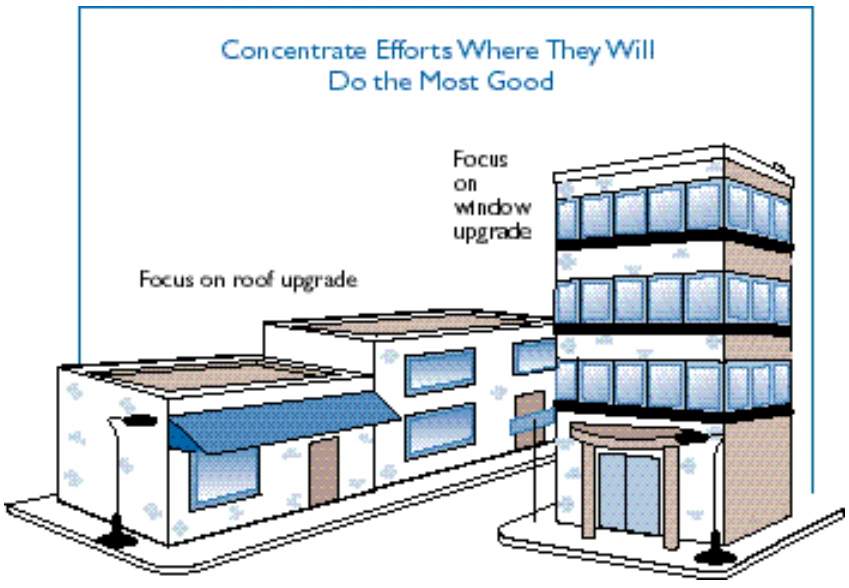
Building Construction

The phrase "set in stone" is frequently used to describe things that cannot be changed and must be accepted as a fact of life. This may be how you view your building's construction and the way it affects your energy bill. Just because your building is set on a firm foundation doesn't mean that you can't make some changes—large or small—that can reduce the impact that your building's exterior has on what you pay to heat and cool it. What's more, most of the changes you make to reduce your energy costs will also bring along improvements in comfort and in your building's appearance.

Fortunately there are many small-scale upgrades that you can make to your building's envelope (the walls, roof, and windows) that can make the building cost less to heat and cool. Unlike the equipment inside your facility, simply changing a wall or a roof just because the original equipment isn't efficient enough isn't really a feasible solution. Sometimes windows of opportunity do occur to upgrade your building's construction at relatively little extra expense. For example, roofs need to be replaced periodically, and the additional expense of adding insulation or reflective coverings at that time can be justified by the savings they will provide. Similarly, energy-saving window upgrades may be worthwhile when your building's facade is being remodeled to modernize its appearance. In turn, when it is time to replace your heating or cooling system, you may find that by investing some money in wall or roof improvements, you can reduce your building's heating and cooling needs enough to reduce the size and cost of the unit equipment you need to buy. Alternatively, if your current system can't quite heat or cool enough on extreme temperature days but is still new enough that you would rather not replace it, you can make building improvements to reduce your heating and cooling loads enough to allow your current system to meet your needs.

Most of the upgrades that you can make to your facility involve reducing heat losses in winter, reducing heat gains in summer, and reducing air leakage throughout the year. The particular envelope upgrades that make the most sense for your building depend on both the climate and the layout of your facility. A business owner in Phoenix, AZ, will be more concerned about what the summer sun is doing to his cooling bill than he would be if his business were located in Caribou, ME. Similarly, the business owner with a 1-story building will

You can reduce heat losses in winter, reduce heat gains in summer, and reduce air leakage throughout the year by upgrading your facility.



By replacing the existing windows, this Rebuild America partnership school improved indoor comfort while reducing winter heating requirements.

Success Stories

Envelope Modifications Provide "Cool" Savings in Eastern North Carolina

A comfortable atmosphere in the classroom is essential to learning. An elementary school in North Carolina was faced with unbearable heat in the summer and erratic temperatures and drafts in the winter; neither condition was conducive to learning. To help ease the uncomfortable atmosphere, the administrators decided to provide air conditioning by replacing the school's existing steam heat system with fan coil heating and cooling units that had individual room thermostats. They also replaced the single-pane windows with double-pane windows and insulated panels. The new windows, coupled with insulation added to the roof in an improvement project a few years earlier, reduced the size of the air-conditioning equipment needed, which resulted in a lower installation cost. What was the result of this air-conditioning and window replacement project? The school reduced its heating costs that winter by nearly 35 percent. And the benefits from replacing the windows were not limited to cost savings; the increased comfort levels created by eliminating drafts and the newer, more modern appearance of the school have boosted the teachers' morale and the children's pride in their school.

Window R-Values*

Single Pane	**1.0**
Double Pane	**2.0**
Triple Pane	**2.9**

Decrease R-Values by at least 20 percent if aluminum frames.

Increase R-Values by about 30 percent if low emissivity.

* See page 69 for more information on R-Values.

probably be more concerned with roof upgrades than a business owner with a 10-story building because the roof has a much larger impact on the 1-story building.

Windows

Windows are one of the most appealing parts of any building, providing its "look" and, of course, the coveted window offices. But windows are also an area where a lot of your heating and cooling costs can go literally out the window. Windows typically have low insulating levels, as anyone who has sat next to a large, single-pane window on a cold winter day can attest. In addition, windows can also allow a lot of unwanted summer heat gain, especially if they're located on the west or south side of the building. In recent years, window manufacturers have developed low-emissivity (low-E) windows with dramatically higher insulating values and reduced heat gains, but it is unlikely that these are being used in your building if it was built before 1990.

Unless you have single-pane windows and live in a cold climate, the savings from replacing your windows with more efficient windows are hard to justify financially unless the replacement is done as part of a larger renovation. You can improve the efficiency of your existing windows, however, by installing window films.

Window films are thin coatings that can be applied to the interior surface of windows to help block radiant heat gains and losses. These coatings are similar to those used in low-E windows. Their primary benefit is in reducing summer heat gains, because they can prevent from 61 to 80 percent of the incoming solar radiation from entering your building. In winter these coatings can help reduce heat losses by preventing 19 to 44 percent of

indoor heat from escaping out the window. In addition to providing energy-cost savings, window films improve comfort by moderating heat losses and gains, reducing glare and overheating, increasing privacy by restricting visibility from the outside, improving the appearance of the windows, and reducing the fading of carpets, furniture, and merchandise. Window films typically cost between $1.35 and $3.00 per square foot to install, and they generally have a lifetime of 7 to 12 years. They must be installed properly to avoid bubbles, cracks, or damage to your windows.

Window accessories also affect your energy costs. White roller shades and Venetian blinds, when fully drawn, reflect heat. Draperies or curtains, when made of a tightly woven, opaque material in a light, reflective color, can reduce heat gain. If a curtain fits tightly against the window, it can also reduce winter heat losses. Awnings on the south, east, and west sides of your building can reduce summer heat gains; trees planted on the east and west sides of the building can also reduce summer heat gains. The chart below provides the simple guide to when you should use your shades, depending on the season and the time of day.

Pull Your Shades

DAY		
SUMMER	**Down**	Block the sun
WINTER	**Up**	Let in the sun
NIGHT		
SUMMER	**Up**	Let building heat out
WINTER	**Down**	Keep building heat in

Roofs and Walls

Your building's roof can generally be improved two ways: by improving the insulation and by improving its reflectivity to reduce heat gains. Your priorities will depend upon the type of building you have and where your business is located. Roofing improvements are generally better investments for buildings that currently have a poorly insulated roof and in locations with extreme temperatures in either summer or winter.

If heating costs are a priority at your facility, or if you work in a warm climate and have an attic, roof insulation could be a good investment. If your business has attic space, insulation may be added at any time to the attic floor at a relatively low cost either by blowing in insulation or by installing batts of insulation on the attic floor. Depending upon the type of roof, insulation may be added on either the inside or the outside of the roof. If you have a flat roof, your best bet will probably be to wait until your roof needs replacement and to install rigid insulation on the roof exterior when the roof is being replaced.

How much insulation is enough? Your state or local building codes will usually require a minimum level of insulation, but keep in mind that this figure is a minimum required amount. Because codes have gradually increased the amount of insulation required, many old buildings will have less than the amount required by current codes. To get a better idea of advisable insulation levels for energy cost savings in your area, check with your state energy office or local electric utility. The American Society of Heating, Refrigerating, and Air-Conditioning Engineers recommends an R-Value between 25 and 30 for optimum energy efficiency. See the chart on page 68 for some roofing rules of thumb.

Roof insulation could be a good investment if heating costs are a priority at your facility or if you work in a warm climate and have an attic.

Roofing Rules of Thumb

Existing Condition	Cost Effective To Add Insulation?
New Construction →	Yes, always. R–19 to R–38 depending on location and codes.
Existing Buildings:	
Current Insulation Level	
0–1 inches →	Yes, always.
2–4 inches →	Yes, if attic is accessible or if built-up roof is being repaired.
5–9 inches →	No, in moderate climates. Just add when remodeling.
	Yes, in extreme climates and where the attic is accessible.
More than 9 inches →	No.

When unconditioned air from outside slips into your building, or conditioned air from inside seeps out, you have to pay to heat or cool the extra or replacement air.

If your air conditioner runs significantly more than your heating system, ask your roofing contractor about reflective roof coverings for your area. Recovering the roof with a light-colored stone, coating, or membrane is less expensive than a full roof replacement. The lighter color will cause your roof to absorb less heat and will extend the life of the roof by slowing its deterioration. Another alternative is a roof spray system, which has moisture sensors that control a spray of water over the roof to keep temperatures down. If your building has an attic space, you may be able to install a radiant barrier. A radiant barrier is essentially a layer of aluminum foil that can be tacked to the underside of your roof deck with the shiny side facing down toward the air space in your attic. It blocks 95 percent of the heat that would otherwise be radiated downward from your hot roof deck. All of these options result in lowered roof or attic temperatures, which make your upper floor a much more comfortable place during the summer. In one application in New Orleans, for example, the installation of a radiant barrier and attic vents dropped the attic temperature by 50 degrees. You can imagine the effect on comfort downstairs.

Finally, forced ventilation in attics can drop temperatures by 30 degrees or more for a big increase in comfort and savings.

Reducing Air Infiltration

When unconditioned air from outside slips into your building, or conditioned air seeps out, you have to pay to heat or cool that extra or replacement air. Consequently, it pays to minimize this infiltration, especially because the methods to reduce it are generally inexpensive and easily applied. Reducing infiltration will also improve your occupants' comfort because nobody is comfortable sitting next to a draft.

Use caulk to seal air-leaking cracks and install or replace weather stripping around doors and operable windows. Small air gaps may look inconsequential, but they add up. A 1/8-inch air gap along the opening of a pair of 6-foot-8-inch doors is equivalent to a 10-square-inch hole in the wall. Replace the glass in any broken windows as soon as possible. Make sure all doors and windows close properly and—an often forgotten procedure—cover the exterior portion of any window air conditioners in the winter.

If you have a loading dock, several measures can potentially cut your costs and increase the occupants' comfort and productivity. When the loading dock door is open, make sure that any doors that separate the loading area from the rest of the facility are closed. (If there are no such doors, you may wish to install some.) If the opening is larger than needed, consider making it smaller. Have trucks back up as close as possible to the opening to reduce the amount of heated air escaping the area. If the loading dock door is

regularly left open, install a curtain of plastic strips or an air curtain to help reduce heat loss. Alternatively, consider radiant heaters, as discussed on page 77.

If You Plan To Remodel

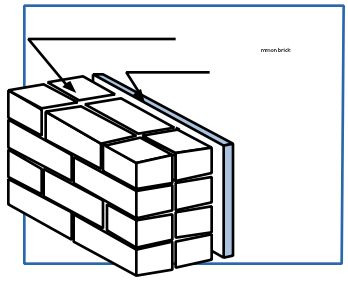
Your options for reducing your building's energy costs are limited to some extent by the choices that were made when your building was built. Making the decision to use energy-efficient windows and appropriate insulation levels is far less expensive when a building addition is still on the drawing board. At this point the actual cost for each upgrade should be considered the incremental cost between the more and less efficient alternatives. The options that provide the best return on investment can be identified by comparing the incremental cost with the energy cost savings that will accrue over the lifetime of the building. Software packages are available and can be used to analyze these choices. If your architect is unfamiliar with these methods, you may wish to hire a consultant to help you make the optimal choices.

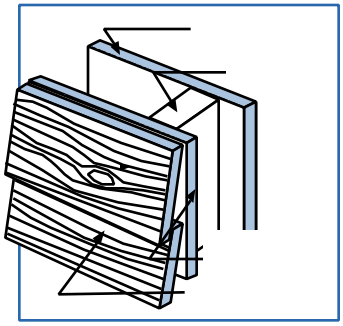
Increasing the insulating value of existing walls may be difficult to justify from a cost-savings point of view. If a cold wall is a significant comfort problem, however, you may wish to do so. If you have frame walls, you can have insulation blown into the wall cavities. Otherwise, you can increase the insulating value by adding a layer of insulation over the existing interior wall and covering it with new wallboard. (You will also need to move out any light switches or electric boxes.) This solution will decrease the size of the room slightly. See the figures on this page for variations of wallboard coverings.

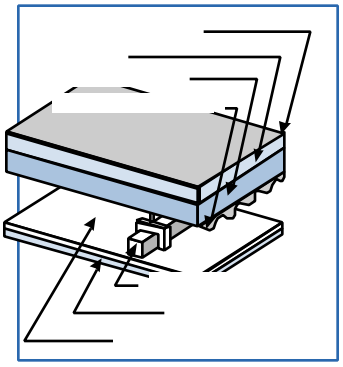
Consider installing a vestibule at your primary entrance, particularly if your business sees a lot of visitors. A vestibule consists of a space between two sets of doors that acts as an airlock to reduce the amount of air that enters or escapes from the building as people enter or leave. You may be able to create one by installing an extra set of doors inside your building, or you may wish to build it as a small addition. This area does not need to be heated or air conditioned. In addition to reducing energy costs, this modification will dramatically increase the comfort of anyone who works near the doors. Studies show that vestibules can reduce related infiltration by more than half. Such a measure likely will not be justifiable solely on energy cost savings unless it is part of a larger upgrade, but it is justifiable when you consider the added comfortable work space it provides.

Technical Closeup: R-Values

R-Values measure the effectiveness of insulation. The higher an object's R-Value, the better it resists heat loss (or gain). Heat loss through an object is inversely proportional to its R-Value, so you get more bang for your buck from increasing the R-Value of a building component that initially has a lower R-Value than you would with a higher one. Increasing insulation from R-1 to R-20 will save you a lot more money than increasing from R-20 to R-40. For example, adding an R-Value of 1 to a window that currently has an R-Value of R-1 represents a 50-percent decrease in heat loss; adding R-1 to an R-15 wall decreases its heat loss by 6.25 percent.


Drawing 1


Drawing 2


Drawing 3

R-Value

	Without Insulation	With Insulation
Drawing 1	R-5	R-12
Drawing 2	R-4	R-8
Drawing 3	R-5	R-9

Heating and Cooling

Heating, ventilating, and air-conditioning (HVAC) systems account for 39 percent of the electric energy used in commercial buildings in the United States. Consequently, almost every business has the potential to realize significant savings by improving its control of HVAC operations and improving the efficiency of the systems it uses through proper design, installation and scheduled maintenance.

1970s-Style Conservation: It Still Works

The most straightforward method for saving on your HVAC bill is simply to operate the systems less, both by turning the systems off (or back) when the building is not occupied and by choosing more efficient temperature setpoints so that the systems run less often.

A week contains 168 hours. If your business operates during only 40, or even 80, of those hours, you occupy your facility during only a fraction of the week. Consequently, savings are available by setting back your thermostat when the building is unoccupied. The term "setting back" is used to indicate both changing the temperature setting (setting back to a lower temperature in winter and setting up to a higher one in summer) and making sure that the fan switch on the thermostat is set to "auto" rather than "on." A fan left in the "on" mode runs nonstop 24 hours per day; in "auto" mode, the fan cycles on only when heating or cooling is being supplied. In some instances the fan savings can be significant even when only minimal temperature setback changes are made. If your system draws in ventilation air from outdoors, cycling the fan during unoccupied hours can also help with humidity control in humid areas.

How much can you save? That depends upon your climate, the size and shape of your building, how much you set back your thermostat, and how many hours per week your business operates. Substantial savings are also available by adjusting your temperature setpoints—lower in the winter and higher in the summer. Change your thermostat settings gradually, no more than a degree or so per week, to see how low (or high, for summer) a setting you need to maintain a comfortable facility. Make these changes without advertising the fact that you are doing so to avoid having staffers begin grumbling about changes before they can actually feel them. This method can also help identify problem areas in your system. Check out the areas where you first receive complaints about comfort to determine whether the problem is one of inadequate air supply, excessive drafts, or intense sunlight.

The Consortium for Energy Efficiency (CEE) reports that up to 50 percent more energy could be saved with proper installation, sizing, and maintenance of commercial central air conditioners and heat pumps.

Save on your HVAC bill by turning the systems off (or back) when the building is unoccupied.

Success Stories

Programmable Thermostats Bring Needed Comfort in Seattle

Centerplex, a Seattle-based ENERGY STAR® small business partner, owns a 26,500-sq.ft. commercial office with 43 tenant firms and 100 occupants. Centerplex's owner, Jonathan Pool, has implemented a variety of energy-saving modifications that have reduced his electric bill by 50 percent. Among these modifications is the installation of ten programmable thermostats, which save energy by resetting the heating and cooling setpoints when sections of the facility are unoccupied. The programmable thermostats provide the added benefit of reducing tenant complaints about erratic temperatures. The programmable thermostats, along with energy-efficient lighting and window improvements, have netted a savings of $23,000 per year within an overall payback period of only 1.5 years. Mr. Pool made an interesting observation about his efficiency efforts and their ultimate effect on his bottom line. "I think there is a spillover effect. When you rent space to others the practices that you engage in attract compatible people. Conservation attracts people who support conservation. They generate less waste and are easier on both each other and the physical plant." His overhead goes down, and his profit goes up.

HVAC Tune-Up

The Air Conditioning Contractors of America recommends scheduled maintenance on your heating and air conditioning systems twice annually by a licensed HVACR contractor. These scheduled maintenance programs and system checks should include the following:

- Check the system's connections.
- Check for proper refrigerant charge (and combustion efficiency where appropriate in the fall.
- Inspect and clean coils, straighten fins, and replace filters.
- Inspect and oil fan motors.
- Inspect and repair ductwork leaks and insulation voids in unconditioned spaces.
- Check for proper ventilation and economizer operation.
- Check for proper airflow at unit and each zone.
- Check for proper control settings and safety shut-down functions.

Note: These maintenance and system checks are just as important as changing the oil in your vehicle every 3,000 miles.

1980s Efficiency Improvements: Programmable Thermostats

Although night-setback and temperature-setpoint changes are simple enough to be done manually, an automatic control is much more efficient and reliable. Electronic, programmable thermostats, which allow you to program in desired setpoint and cutoff times for a 7-day week, are available for $50 to $200. Most models include manual override features, so an executive who needs to come in on a Sunday afternoon when the system is in setback mode can override the setback and work in comfort without having to reprogram the system. Be sure to locate the thermostat in a location where the temperature is representative of the entire area served by the system—not next to the air-conditioning diffuser or a coffee pot. Many businesses find it worthwhile to install a locking enclosure around their thermostats to avoid unauthorized tampering with the setpoints. If you have a heat pump, be sure you get a heat-pump-programmable thermostat with a "smart recovery" feature, which will bring your system on early enough to minimize the use of electric strip heating. Heat-pump thermostats cost about twice as much as other thermostats because they have to control multiple types of heating.

1990s and Beyond: Whole-Building Energy Optimization and Management Systems

Programmable thermostats are effective and work quite well, especially with individual-unit air conditioners and heaters. If your facility uses larger, central systems such as boilers and chillers, you may wish to use an energy management system (EMS) instead. As we approach the next millennium, the EMS market will likely expand into smaller and smaller facilities. In addition to the setpoint and night-setback features, which can be handled by a programmable thermostat, an EMS can be used to provide savings in many other ways. Depending on the type of system you have, an EMS might be used to provide some of the following money-saving automatic control functions:

- Consider installing an economizer. There may be times when you need cooling in the building but the outside temperature is low. An economizer allows your system to circulate outdoor air for free cooling during these periods. Rooftop units have had economizer options that can provide free cooling for many years. If your rooftop(s) have economizers, they need to be checked for proper adjustment and operation with your scheduled maintenance. If your rooftop(s) do not have economizers, consider having them installed by your HVACR contractor. The payback period is typically very short.
- Adjust supply-air temperatures based on indoor and outdoor temperature and humidity to let the heating and cooling systems operate most efficiently.

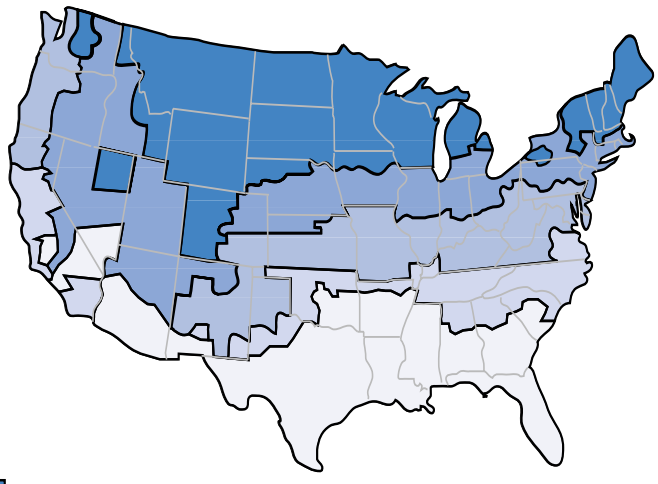
Approximate Percentage Savings From Thermostat Setback

Degree-Days*	Setback Temperature		
	60° F	55° F	50° F
1,000	13%	25%	38%
2,000	12%	24%	36%
3,000	11%	22%	33%
4,000	10%	20%	30%
5,000	9%	19%	28%
6,000	8%	16%	24%
7,000	7%	15%	22%
8,000	7%	13%	19%
9,000	6%	11%	16%
10,000	5%	9%	14%

*Look up your degree-days on the map below or call your utility for exact data. For a definition of "degree-day," see the glossary in section 3.

Savings based on 65 degrees Fahrenheit and assuming setback for 14 hours per weeknight and all weekend.

Source: "Reducing Energy Costs Means a Better Bottom Line." National Frozen Foods Association/U.S. Department of Energy.



Zone 1 — Greater than 7,000 heating degree-days
Zone 2 — Between 5,500 and 7,000 heating degree-days
Zone 3 — Between 4,000 and 5,500 heating degree-days
Zone 4 — Less than 4,000 heating degree-days
Zone 5 — Less than 4,000 heating degree-days and greater than 2,000 cooling degree-days

If you plan to upgrade any heating or cooling equipment, first implement your other ENERGY STAR upgrades. Earlier upgrades (such as lighting replacements or building construction improvements) may change the size requirements for your new heating or cooling system.

- Adjust chilled-water and hot-water temperatures based on indoor and outdoor temperature and humidity to let the cooling and heating systems operate most efficiently.
- Implement holiday period automatic setpoint adjustments.
- Monitor space temperatures to minimize overheating or over-cooling of spaces on a zone-by-zone basis.

An EMS can be used to control other functions in your building as well, such as lighting. It can be monitored and controlled from a console in a remote location, such as your home or your maintenance manager's home. EMS suppliers typically estimate that their EMS can cut the heating and cooling bills of a business with a central chiller and heating system by 10 to 50 percent (many estimates are clustered in the 20-percent range).

An EMS also can manage your electrical loads, prevent peak loads and optimize your electrical rate with your electric utility.

Improving Your System Efficiency

The remainder of this section offers suggestions on how to improve the efficiency of various types of HVAC systems. Because advice is offered on a variety of different systems, not every suggestion will apply to your facility. One piece of advice does apply uniformly to every business, however, regardless of the type of HVAC system: Maintain your HVAC system.

Regular maintenance is an often-overlooked key to saving on your HVAC costs and improving the performance of your system. Although some maintenance jobs may require calling in an outside technician, many can be accomplished inexpensively using in-house staff. Because it also extends the life of your HVAC equipment, regular maintenance provides significant cost savings for minimal investment.

Most procedures will be included in your bi-annual comprehensive maintenance agreements with your licensed HVACR contractor. This type of system checkup will typically cost less than $100 for a single system, with additional units included at a discount. Some examples of systems checks and standard maintenance procedures that you or your contractor should do on HVAC systems include:

- *Replacing your air filters regularly.* Accumulated dirt and dust make your fans work harder. Clean filters help system performance and help reduce allergens in your office. You can do this without a whole system checkup.
- *Cleaning the heat-transfer coils in heat pumps, air conditioners, and chillers.* Make sure that leaves and plants are not obstructing outdoor coils and have any bent coils straightened. In addition to saving energy, this measure will increase the capacity of your system.
- *Inspecting ducts and piping for leakage and missing or damaged insulation and making the indicated repairs.* Insulation is especially important in unconditioned spaces and leaky ductwork is one of the biggest contributors to cooling loss in buildings.
- *Making sure that furniture or other obstructions do not block air flow around radiators, convectors, and air intakes and diffusers.*
- *Identifying any areas in your facility that are unused but are being conditioned.* Consider turning off the HVAC to these areas or closing the vents.

- *Adjusting temperature and humidity setpoints seasonally.* Unless it is absolutely required for humidity control, consider turning off "reheat" from late spring to fall.
- *Having your fuel-fired boiler or furnace checked out at least annually, before the heating season starts.* Have the technician check the combustion efficiency and report the results along with any suggestions for improving boiler efficiency.
- *Repairing your old valves and steam traps.* A steam trap costs approximately $50. If broken, it can waste hundreds of dollars each winter. One supplier estimated that an average of 20 percent of traps are broken nationwide. Broken steam traps not only waste money and energy, but they also cause extreme discomfort.

In addition to the maintenance changes suggested here, making operational changes and/or upgrading some aspects of your HVAC system may result in significant savings. These upgrades are more complex in scope and should be undertaken only after consultation with an engineering professional.

Things to look for in an HVACR contractor:

- The contractor complies with state and local codes and regulations and carries the proper business and workers' compensation insurance.
- The contractor is prompt and courteous and provides fast, reliable service while attempting to perform service at your location.
- The contractor has the skill and knowledge not only to service your equipment, but also, if necessary, to design and install the right system for you.

When consulting an HVACR contractor:

- Ask the contractor for references. Current and former customers are an excellent source of information. Call these individuals and ask if they were (are) pleased with the contractor's work. Make sure the references are recent or current customers so that you get timely information on the contractor's business practices.
- Ask the contractor about his or her license. If a license is required in your area, ask for the license number.
- Always ask for a written price quote and information on service maintenance agreements (SMAs).
- Compare warranties and SMAs. The terms and coverage of warranties and SMAs can vary greatly. Compare them carefully. Are parts and labor included, or only parts, or only labor? Ask what type of repairs and parts are included. The cheapest SMA is not always the best buy.

Tips for Selecting Heating and Cooling Systems

- Proper sizing is critical to efficient performance.
- Check if utility rebates are available.
- When buying properly sized heating/cooling equipment, look for the ENERGY STAR label – your guarantee of savings. For more information, visit www.energystar.gov/products or ask for "small business tech support" at 1-888 STAR YES.
- Call the ENERGY STAR hotline (1-888-STAR YES) to request all the materials you need to make you an "energy smart shopper."

The Air Conditioning Contractors of America Web site is one of many with useful information about how to find a quality contractor. See page 9 for a list of others.

Success Stories

HVAC Equipment Pays Back in North Carolina

The cost of replacing HVAC equipment can be a burden for a small business, but a smart shopper can use the replacement as an opportunity to reduce operating costs by purchasing energy-efficient equipment.

Sud Associates, an engineering firm in Durham, NC, needed to replace HVAC equipment in its 2,200-sq.ft. office building. The 23-year-old system was a gas furnace with a continuously burning pilot light and an open flue. Cooling was provided by a condensing unit with a poor seasonal energy efficiency ratio (SEER) of 7.

The new heating system included a gas furnace with electronic ignition and a forced draft fan. Cooling equipment with a SEER of 12 was installed. This new system outperforms the old one, cutting both electric and gas usage while increasing comfort. The electronic ignition eliminates the continual gas use by the old pilot light, and the forced draft fan contains any heat lost through an open flue. The new gas furnace has cut gas usage by more than 20 percent in its first heating season. Elimination of the pilot light's energy use will add to the total savings. As the system is in its first year of installation at the time of this writing, actual cooling savings results are not available. However, electric savings due to the increased energy efficiency of the cooling equipment is predicted to be approximately 40 percent.

- Ask the contractor if he or she is a member of a national professional trade organization such as the Air Conditioning Contractors of America (ACCA). Such affiliations demonstrate that contractors have access to the latest technical information regarding HVAC systems, and make quality an integral part of their company operations.

This is Stage Five

Do you remember the five-stage approach from pages 31 and 32? If you plan to upgrade any heating or cooling equipment, be sure to do this after your other ENERGY STAR upgrades have been implemented because your earlier upgrades (such as lighting replacements or building construction improvements) may result in a change in size requirements for your new heating or cooling system. If you have a large or architecturally unique site, insist that the contractor complete a sizing worksheet or run a computer-

Technical Talk: Special Types of Heating and Cooling Systems

Systems That Simultaneously Heat and Cool. In reheat systems, air that is colder than required is supplied to a specific area and then reheated before it enters the room. In dual-duct or multizone systems, heated air is mixed with cooled air. Although these systems provide good temperature and humidity control, this simultaneous heating and cooling is inherently wasteful and should be minimized. If this is being done for humidity control, consider alternatives such as desiccants and heat pipes.

Single-Zone Chilled-Water Systems. Consider reducing the air volume and, during relatively dry seasons, raising the cooling supply temperature. Also consider conversion to a variable-air-volume (VAV) system.

Water-Side Systems. Consider downsizing oversized pumps and motors, installing variable-speed drives on pump motors, and converting single-loop configurations to a configuration with primary and secondary loops.

Water-Cooled Centrifugal Chillers. If your chiller predates 1990, it may be using R-11 or R-12 refrigerants. Manufacture of these has been banned due to the Clean Air Act Amendments of 1990, reducing their availability and making their prices skyrocket, so any upgrade should consider converting the chillers to utilize newer refrigerants. Consider replacing your chiller if it is more than 20 years old.

Boilers. Consider replacing an oversized, inefficient boiler with a smaller, more efficient boiler. Also consider upgrading an existing boiler with energy savings options such as a newer, more efficient burner (which will also reduce emissions), baffle inserts (to increase the efficiency of fire-tube boilers), combustion controls (to optimize efficiency each hour), warm-weather controls for hot-water boilers (to reduce the water temperature during milder weather), economizers (to preheat feedwater), and condensate return systems (for open-loop steam boiler systems). If you have multiple boilers, keep in mind that it is more cost effective to run one of them at full load than both at part load.

Large Central Systems. If you have a large central system and you find that one area of your facility operates for substantially more hours than the others, it may be cost effective to install a smaller, dedicated system in that area.

ized sizing analysis for your facility in its current state of repair. If you think the results inflate your needs, seek another quote.

Never buy oversized heating or cooling equipment on the theory that more capacity is better. This simply is not true. Grossly oversized cooling equipment will cycle too often and will be unable to sufficiently dehumidify your space, which creates a serious comfort issue. Such equipment will also cost more to run all year long. Heating equipment will be equally inefficient if oversized. This advice is difficult, perhaps the most difficult in this whole guide, to follow. Nobody wants to spend $5,000 on a new air conditioner and find themselves sweating when cooling is sought. But both comfort and costs are at stake. Get the right size, not the right size plus one, and you'll be happy.

If your system was properly sized before making any ENERGY STAR improvements, your contractor may find that your system is now oversized and savings can potentially be realized by downsizing portions of it. If your system was undersized before you began your ENERGY STAR upgrades, you may find that your improvements have, in effect, balanced your loads and capacity by reducing your building loads and increasing your equipment capacity.

Hot New Technologies: Variable-Speed Drives, Heat Recovery, and Radiant Heating

Variable-Speed Drives (VSDs). If you have a larger system in your building, you may be able to take advantage of the savings available through installing VSDs on air blowers or even pumps. VSDs allow sophisticated control of how much air or water is provided by heating and cooling equipment, which has a significant effect on how much energy is consumed.

Heat Recovery. Your business may require high levels of fresh air (for example, a laboratory with fume hoods). Installing heat recovery equipment will allow you to recapture some of the energy you have invested in heating or cooling that air and transfer it to the fresh air stream.

Radiant Heating. For areas where high ceilings, high infiltration, or low insulation levels make heating the air costly, natural gas-fired radiant heating (which heats occupants directly) is the answer. For warehouses, shop areas, and loading dock areas, installing radiant heaters can lead to big savings on your heating bills.

To find out more about these and other technologies, call the toll-free ENERGY STAR hotline at 1-888-STAR YES and ask for materials suited to your business. And remember, we're here to provide you with unbiased technical information for all your energy- efficiency upgrades.

Time for Another Repair?

Due to the high cost of large HVAC equipment, the energy savings alone may not justify replacement of equipment that is in good working order. If your equipment requires frequent repairs or is nearing the end of its life expectancy, however, it may be wise to consider replacing it from a preventive maintenance standpoint and an energy savings standpoint, as a scheduled replacement can generally be negotiated at a lower cost and with less inconvenience than the emergency replacement of a failed unit. Call your utility to find out if it offers rebates on high-efficiency equipment.

For more information on heating/ventilation/ air-conditioning, and links to information on other energy efficiency/renewable resource technologies, as well as related industry trade associations, institutes, and organizations, visit the US Department of Energy's EREN (Energy Efficiency and Renewable Energy Network) Web site at http://www.eren.doe.gov/ consumerinfo/assn.html.

Success Stories

A Successful Recipe in Renovation

Jan and Eddie Malone knew they had a challenge ahead of them when they purchased the Hotel Alice in 1999. Not only did the Malones have to become educated in the world of small business, but they had to contend with a complete renovation of the Hotel Alice. The Malones' vision was to turn the abandoned, three-story, 11,500-square foot historic building into a Bed and Breakfast, with a coffee shop/restaurant and antique shop on the first floor. Built in 1902, the building was also eligible for membership in the National Historic Registry, entitling the Malones to a 20-percent tax credit. The Malones also worked with a local architectural firm to review the existing building structure and make recommendations to keep the building's charm and historical features.

A view of the front of the Hotel Alice in Ellisville, MS.

In March 2000, the Malones learned about the Rebuild Mississippi team, which performed technical analyses on the building envelope, lighting, windows, plumbing, gas and electric systems, heating and cooling systems, roofing, and insulation and made numerous recommendations for improvements.

After reviewing all of the improvement recommendations, the Malones decided on a number of retrofits and renovations, which included the installation of a new HVAC system, energy-efficient windows, hot water heaters, and reflective roofing. The approximately $350,000 in private investments needed to complete the retrofits has already yielded significant savings for the new hotel, which also serves as a meeting place for conferences, receptions and a variety of community activities. Utility bills for the business are proving to be 50 percent less than that of comparable enterprises in the area. In March 2001, Rebuild America honored the Hotel Alice Project with its Energy Excellence in Commercial Buildings Award.

To learn more about the Hotel Alice Project and track their progress, visit **www.hotelalice.com**.

Other Ideas for Energy Optimization

Ideas on energy optimizations and related profit enhancements are far more numerous than the ones presented in this guide. The possibilities are endless. In this section we will point out a few more specific ideas, but don't let us constrain you. Anywhere energy is used can be an opportunity for improvement.

Motors

The rules of thumb here are simple. First, buy high-efficiency motors whenever you replace old motors. Second, if you use a standard efficiency motor (less than 100 horsepower) 24 hours every day, replace it with its high-efficiency equivalent right away and your profits will increase in less than five years. Beyond that, your decision is mainly a factor of the motor-cost premium, hours of use, and your electricity cost, shown in the table in dollars per kilowatt-hour ($/kWh).

Cooking Equipment

Don't preheat your cooking equipment. Don't preheat your electric or gas equipment for more than a few minutes. Although chefs are not likely to appreciate your telling them how to run their kitchens, it's worth a try.

Use the microwave or gas stove in place of electric resistance cooking when possible. Both cost less.

Buy the efficient version. Many fryers, broilers, soup kettles, and other equipment have optional controls and features that minimize their energy use. Often they are worth the additional cost, but we cannot offer a guarantee.

Improve kitchen ventilation. Turn off your makeup air unit whenever you are not cooking and especially at night. These units, together with the exhaust hoods, demand tremendous amounts of energy. You need to provide a safe and comfortable environment without odors and smoke, but turn both systems off when they are not needed.

When buying new equipment or appliances, look for the ENERGY STAR label, your guarantee of savings. For more information, visit www.energystar.gov/products or ask for "small business tech support" at 1-888 STAR YES.

Should You Buy a High-Efficiency Motor?

Example: 25 Horsepower Motor
$208 Cost Premium for High-Efficiency Motor
$1,028 Total Cost for High-Efficiency Motor

Motor Use Hours/Year	Annual Cost Savings at Electric Rate Shown ($/kWh)			
	$0.05	$0.08	$0.10	$0.12
1,000	$28	$44	$56	$67
2,000	$56	$89	$111	$133
4,000	$111	$178	$222	$267
6,000	$167	$267	$333	$400
8,760	$243	$389	$486	$584

Always buy standard efficiency.
Buy high-efficiency motor upon burnout.
Buy high-efficiency motor immediately.

Fuel Conversions

Electric resistance heating is typically the most expensive option when compared with natural gas, propane, and other fuels. If you already have gas onsite but still use electric-resistance heat for water heating, clothes drying, cooking, or other processes, ask your plumbing or general contractor to tell you what it will cost to convert your equipment. It could be a very good investment for equipment you use often or were going to replace anyway.

Vending Machines

Let's face it, vending machines are everywhere. They are in places such as office buildings, cafeterias, theatres, auto repair shops, congregation halls and various other locations. In other words, if you are thirsty and in need of a cold drink, you do not have to look very far to find a vending machine that meets your needs.

That's the good news, the bad news is that with so many vending machines operating 24 hours a day, energy waste is inevitable. In addition, this waste is undoubtedly causing stress on our natural resources and environment. A typical vending machine consumes about 3,000 kWh per year; four times that of a residential refrigerator!

Lighting accounts for one third of the total power consumption in a typical vending machine.

But there's hope! Today manufacturers are rethinking the design of vending machines with more of a focus on environmental impacts. And now with the emergence of new and exciting "smart controls", the industry has the opportunity to reduce energy waste even further. Major energy saving advancements have been made in the following areas:

Efficient Lighting. Lighting accounts for one third of the total power consumption in a typical vending machine. Traditional T12 fluorescent lamps can be successfully replaced with higher quality and more efficient T8 lamps. (Note, de-lamping is sometimes an option, but there are concerns of possible negative impacts on product sales)

Improved Refrigeration & Seals. Improvements in compressor efficiencies and reductions in thermal leaks (through seal and insulation advancements) have led to machines that can minimize demand, usage and waste, while maintaining a superior product for customers.

"Smart Controls". Timers and new control advancements employing sensors are now being used to reduce energy waste without posing a risk to the products' ideal temperature and environment. These controls can "sense" when a product is needed and not waste energy consumed during long stand-by periods.

On a less technical note, the heating effect of the sun will cause a vending machine to consume more energy to cool its products. If your business's vending machines must be outside, locate them in a shaded area if possible.

Saving energy in vending machines can be achieved by both the purchase of new efficient models or by retrofitting existing models with "smart controls". Employing these tactics can save anywhere from 20 to 50 percent of the machines' energy consumption. Now that's a lot of soda!

Point-of-Use and Pressurized Water Coolers

Point-of-use (POU) and pressurized water coolers use a common refrigeration cycle to chill water for on-demand drinking. POU is the more common type of cooler typically using five

gallon bottles of water and dispensing the water through a tap using gravity to force out the water. Some of these POU coolers have heaters built in to provide on-demand hot water as well. Typical energy consumption of these devices may be 300 to 400 kWh/year with cooling only or 500 to 1,000 kWh/year with a heater. Pressurized water coolers use potable water from a building's domestic water supply providing on-demand chilled water usually by depressing a mechanical button or bar. Typical energy consumption for these is 300 to 400 kWh/year as well.

Water coolers are only needed during business hours. Your water cooler may be running even when no demand for drinking water exists. If you installed a simple plug-in timer set for business hours only, you could cut the operating cost for your water cooler in half. Energy consumption would drop from 300 to 400 kWh/year to 150 to 200 kWh/year as a result of this simple energy efficiency measure. If your business is only open during the workweek, your energy savings could be even greater as the timer shuts down your water cooler on the weekends. Currently ENERGY STAR is working on a performance standard for an ENERGY STAR labeled water cooler. The basis of the proposed label is simply adding a timer to the water coolers to qualify the manufacturer for an ENERGY STAR label. Your business can be ahead of the program by simply adding a timer today.

Many POU water coolers have an additional feature of providing instant hot water. This is an expensive option when you consider the energy consumption. Just cooling the water requires about 100 W of cooling power, but heating the water may require 500 W of heating power, five times as much energy! Consider whether or not your business really needs this option. If it does, again, consider adding a timer to reduce energy consumption during idle periods. Also, if your business's POU water cooler has a hot water option, look for a small switch on the back of your unit. Many manufacturers include this switch to turn off the hot water feature. If so equipped, consider turning off the hot water supply if your business does not use the hot water feature.

Icemakers

Icemakers are found in most hotels, gas stations, restaurants, and convenience stores. Icemakers use a common refrigeration cycle to produce ice cubes for general use. Most icemakers use air-cooled condensers, like refrigerators, to reject heat. Some use potable water to cool the condenser making them more energy efficient, but costing the user added operating costs with water and sewage fees. Icemakers range in size from 100 to 1,500 lbs/24 hrs of ice generation.

If your business operates icemakers, you have a tremendous opportunity to save energy by selecting an energy-efficient model.

Using ENERGY STAR labeled water coolers can save your business as much as $47 per unit!

Success Stories

Spaan's Cookie Company's 4,500 sq.ft. office building was built in the early 1900s in the historic town of Galt, CA. The Spaan family has owned the firm since 1896. While protecting their history and architecture, Spaan's implemented a major lighting retrofit (inside and out), new HVAC controls, insulation, flooring, and windows. Annual savings of more than $2,300 are projected, with the 30,570 kWh saved preventing 38,000 pounds of carbon dioxide emissions. Sharon Spaan says, "A very clear benefit is the example of what can be done to bring an old building up to date and make it efficient, while maintaining the historical presence."

A typical brewing element may consume 1,400 watts of energy, more than twice that of a residential refrigerator!

Energy consumption is rated in kWh/100 lbs of ice. Typical energy consumption ranges are from 4 to 13 kWh/100 lbs of ice. Remote condensers (located outdoors) are available on some icemakers. These types of icemakers are advantageous because the condenser's heat rejection is to the outdoors rather than inside your business where the air-conditioning equipment has to remove this heat. Remote condensing is usually available on large units only.

Annual energy consumption of a medium sized icemaker may be up to 5,000 kWh. Compare this to the energy consumption of a standard sized, residential refrigerator. Most standard sized refrigerators consume about 700 kWh/year or less. A single icemaker may consume as much energy as several standard refrigerators! If your business operates icemakers, you have a tremendous opportunity to save energy by selecting an energy-efficient model. Some of the most energy efficient models available in the marketplace may be up to 30 percent more efficient. Shopping for the most energy efficient one will help you save money and increase the profit in your business.

When purchasing an icemaker for your business, inquire about the energy consumption in kWh/100 lbs of ice and compare this energy level with several competitors. Compare air-cooled units with water cooled to determine which is best for your business. Water-cooled units use less energy per pound of ice, but may cost you more operating dollars given the added cost of water and sewage.

Commercial Coffee Machines

Commercial coffee machines are using more energy than you think.

Typical commercial coffee machines use energy both to maintain a supply of water at a certain temperature for instant brewing and to keep multiple pots of prepared coffee warm for employee consumption. The problem with this is that some coffee machines are designed to maintain a very hot water temperature at all times, even when not brewing coffee. The machine's energy-intensive brewing element turns on and off a few times an hour automatically to maintain that temperature. A typical brewing element may consume 1,400 watts of energy, more than twice that of a residential refrigerator! The only way to stop the brewing element from activating is to manually turn off the power switch (usually in the back of the machine) when it is not needed, i.e., overnight and weekends. The red indicator light switches that control the pot warmers do not control the brewing heating element. So even when all those red indicator lights are out and there is no coffee activity and you think everything is fine – you are still using energy!

To make sure that your coffee machine is not wasting energy, always check that the main on/off switch is in the off position when not in use. Manually performing this function is probably the simplest way to proceed, but for those of you that like gadgets, there are always timers that can be used to automate the process. One last thing to remember though, if you do turn off the coffee machine for the night or weekend, allow several minutes (consult your coffee machine operator manual) in the morning to let the machine warm up.

Each vending machine, that takes advantage of the VendingMiser (shown below) can save up to $75 a year in energy costs.

Success Stories

Vending Machines Prove to be Prosperous

The Moscow, Idaho School District was looking for a quick and easy way to begin to save energy and their facilities budget and the Avista Utility Corporation had just what they were looking for. Avista was offering VendingMiser units free of charge to communities in their service territory throughout northern Idaho and southern Washington. Avista's program would provide new, energy-saving technology, but allow their clients to take advantage of the payback costs.

The VendingMiser, which is manufactured by Bayview Technologies, Inc., uses a customized infrared sensor that limits the energy supplied to the machine when the surrounding area is unoccupied. The machines also are equipped with smart controls that "learn" the temperature of the room, increasing the power to the machine when necessary and ensuring the products remain at an optimal temperture. Taken together, these energy-saving measures reduce maintenance costs and extend the useful life of the vending machine. Each VendingMiser saves about 1,500 kWh of electricity a year, averaging approximately $75 a year per machine.

In 2000, Avista installed 20 units in six of Moscow's schools. During the first six months of use, an additional 110 units were installed throughout the community. Currently, there are plans to install an additional 130-140 units. Once all of these machines are installed, Moscow, Idaho, will save about $375,000 kWh or $18,750 a year.

If You Don't Do Anything Else... 12 Simple, Sure Energy Savers:

Energy Star and Rebuild America advocate that optimal energy and dollar savings are the result of comprehensive efficiency upgrades. Comprehensive upgrades address all efficiency opportunities that offer an acceptable return-on-investment. The energy productivity of equipment can be enhanced just as the productivity of labor and capital can be managed for improvement.

This can sound complicated, and achieving optimal energy efficiency almost always requires professional technical assistance. However, if the requirements for comprehensive upgrades may stop a small business from taking action, there are twelve reliable, low-risk, high-return actions that are relatively simple.

Let's overview the comprehensive approach, first. In addition to the facility's "shell" (doors, windows, roofing, walls, floor, with their varying insulation/resistence values, reflectance, and thermal mass), the facility has "systems" (such as lighting, chillers, space heating/ventilation/air-conditioning, water heating). The facility's energy costs are also driven by equipment (computers, copiers, printers, fax machines, water heaters, water coolers, etc.) appliances (refrigerators, washers/dryers, dishwashers, stoves, vending machines, etc.). And, of course, the hours of operation, climate, type of business, and local utility rates, are also major factors in energy costs.

Sound complicated? Sure it does, but the highest savings require a strategic investment of time and money. That's why many of America's largest institutions and corporations have not yet implemented all the financially viable actions possible to save money with energy efficiency, even with on-site facility managers, and easy access to capital for improvements.

The above comprehensive list can be somewhat overwhelming for the smaller facility owner/operator, who probably lacks a professional facility manager "down the hall," or faces tough decisions on capital improvement and maintenance budgets. An applicable perspective here is that "perfection is the enemy of good." Meaning... if comprehensive efficiency upgrades are "too much," then key, strategic upgrades are a lot better than doing nothing, even if targeted upgrades are not optimal and comprehensive.

To this end, Rebuild America and Energy Star for Small Business suggest that "if you don't do anything else" at least implement all you can from this list of twelve simple energy savers.

1) Turn off lights and equipment when they are not in use. Seems obvious, but high utility costs often include paying for energy that is completely wasted. To automate this function, read on.

2) Buy Energy Star labeled office equipment, and other products, when needed, and be sure the "stand-by mode" function is activated. This automatic "sleep mode" saves energy and money when the equipment is not in use, by reducing the "vampire" effect of "instant on" (always on) equipment, which is constantly drawing power.

3) Install "occupant sensors" in the proper locations to automatically turn off lighting when no one is present, and back on when they return. Sensors add convenience as well as save money. But, even good equipment can be installed wrong, so don't install the sensor behind a coat rack, door, or book case. It must be able to "see" the motion of occupant approaching an unlit area to turn on the light before, or as they enter. The savings come when people leave an area, and the sensor ensures that the lights are always, automatically turned off, until someone returns. Although, you, personally, never forget to turn off the lights, just think about all those other people wasting money.

4) Adjust lighting to your actual needs; use free "daylighting." This means turn off or dim your lights when daylight is adequate, or use automatic "daylight dimming" ballasts/controls to do this for you. To prevent computer screen glare, eyestrain, and headaches, use limited "task lighting" and do not "over-light" the area. Too much light can be as bad for visual quality as too little light - and it costs a lot more.

5) "Tune-up" your HVAC system with an annual maintenance contract. Even a new Energy Star labeled HVAC (heating/ventilation/air-conditioning)

system - just like a new car - will decline in performance, without regular maintenance. A yearly "maintenance contract" will cost about $100, but can save even more than it costs, and the contract automatically ensures that your HVAC contractor will provide "pre-season" tune-ups before each cooling and heating season.

6) Regularly change (or clean if reusable) the HVAC filters with your own "do-it-yourself" labor for a high "return-on-investment." During peak cooling or heating season, change or clean your filters every month; they cost about $2-3 each. Dirty filters can cost up to $5 a month extra, overwork the equipment, and result in dirtier indoor air. Consider purchasing "electrostatic" filters, which are washable, long lasting, and provide cleaner air. Clean or change filters more often if smokers, or pollution sources are present.

7) Install a programmable thermostat to automate your HVAC system. An "old-fashioned" thermostat turns the HVAC on and off based on temperature, not whether the building is occupied, or whether you benefit from the cooling/heating. This solid-state, electronic device can optimize HVAC operation "24/7" based on your needs. For example, instead of heating or cooling all night, so you can enter a comfortable building in the morning, this "smart thermostat" can turn on the HVAC one hour before you arrive, based on your daily/hourly needs. The cost can be $100 to $200, and it could cut your HVAC costs about 30 percent.

8) Replace incandescent light bulbs with compact fluorescent lamps (CFLs), wherever appropriate. CFLs cost about 75 percent less to operate, and last about 10 times longer. Enough said.

9) Install LED (light-emitting diode) exit signs. Your current fixture may accept a simple, "screw-in" lighting element to replace the small incandescent bulbs that burn out with frustrating frequency. This string of LEDs will cost about $15 to $20, will last decades, give brighter light, and end risky ladder climbing to replace bulbs. If your current exit sign will not accept the screw-in lighting element, a new LED exit sign fixture costs about $100, and will still save about 90 percent over incandescent bulbs' operating costs.

10) Control direct sun through windows. During cooling season, block direct heat gain from the sun shining through glass on the East, and especially West sides of the building. Depending on your situation, there are several options such as "solar screen," "solar film," awnings, and vines. Over time, trees can attractively shade the glass and building. Interior curtains or drapes can help, but it's best to prevent the Summer heat from getting past the glass and inside.

    During heating season, with the sun low in the South, unobstructed Southern windows can contribute heat gain during the day, but should be covered at night.

11) Use fans. Comfort is a function of temperature, humidity, and air movement. Moving air can make a somewhat higher temperature and/or humidity feel comfortable. Fans can help delay or reduce the need for air-conditioning, and a temperature setting of only 3-5 degrees higher can feel as comfortable with fans. Each degree of higher temperature can save about 3 percent on cooling costs.

    Ceiling fans can even be reversed in the Winter, and on low speed will pull warmer air down from the ceiling. When the temperature outside is more comfortable than inside, a "box fan" in the window, or "whole house" fan in the attic can push air out of the building and pull in comfortable outside air. In businesses, like restaurants, with high heat and humidity from cooking, fans can make a huge difference in employee and customer comfort, by giving a boost to air-conditioning. Fans can increase comfort and save money year round.

12) Plug the leaks with weatherstripping and caulking; another cheap "do-it-yourself" job. Caulking and weatherstripping let you manage your ventilation, which is the desirable, deliberately controlled exchange of stuffy inside air for fresher outdoor air. Most commercial buildings require 15-20 cubic feet per minute (cfm) ventilation per person for healthy indoor air. Exceptions and details can be found in "Building Air Quality" at www.epa.gov/iaq.

    However, "air infiltration" in the uncontrolled "leaking" or exchange of inside air (which you paid to heat or cool) at a high rate through cracks around windows, doors, utility switches/outlets, and any other holes between the inside and outside. This can make heating or cooling a building very expensive, and still leave it uncomfortable, "drafty" or "clammy."

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